MINERALS

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MINERAL (CONT.)

- 2 types
- Macro – Mineral
- Micro – Mineral

MACRO - MINERAL

- Requirement more than 100mg per day. Example.
  - Sodium
  - Potassium
  - Calcium
  - Magnesium
  - Chloride

Na+

- Sodium is the principal cation of extra cellular fluid.
- It is found in all types of foods.
- (RDA) is 5-10 gms.
- It is excreted in the urine.
- The concentrations are maintained by Aldosterone.

K^+

- Potassium is intracellular cation; daily requirement is 1 gm/day. Its excretion is through kidney,
- linked to sodium excretion.

FINCTIONS OF Na+ and K+

- **maintains ECF balance.**
- **Nerve conduction**
- **Muscle contraction**
- Sodium is exchanged with Hydrogen in renal tubules to **acidify urine**.
- Sodium pump keeps sodium in far higher concentration outside the cell , **create resting membrane potential**.
- Sodium and Potassium maintain the degree of hydration of plasma proteins, and there by **viscosity of blood**.
- Potassium is important for functioning of cardiac muscle.

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- HYPER NATREMIA
- HYPO NATREMIA

- HYPER KALEMIA
- HYPO KALEMIA

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Ca+ AND P++++

- **Mostly found in the bone.**
- Lesser amount found in the soft tissues, teeth and ECF.

SOURCES oF Ca AND P

- **Milk, milk products, green leafy vegetables are rich in calcium.**
- Phosphate is widely distributed in nature.

- **Calcium: RDA 500mg for adults and 1200mg for children, 1500mg for post-menopausal** women.

ABSORPTION INCREASED BY

- cidic pH solubilizes Calcium salts, promote absorption.
- High protein diet favors absorption
- Vitamin D
- PTH, Calcitonin

- Normal blood concentration is critically maintained at 9-11 mg %

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ABSORPTION DECREASED BY

- high fiber diet, oxalates
- Glucocorticoids

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FUNCTIONS

- Calcification of bones and teeth.
- blood coagulation
- Neuromuscular transmission.
- Muscle contraction
- Acts as secondary messenger in hormone action

P

- Phosphorus: Dietary sources are cheese, milk, nuts. Eggs and organ meats.

- Absorption and regulation is similar to that of Calcium

FUNCTIONS

- Constituent of bone and teeth
- Needed for the synthesis of energy rich molecules like ATP and Creatin phosphate.
- It forms Phosphate buffer in blood.
- Constituent of phospholipids, biomolecules and coenzymes (TPP)

TRACE ELEMENTS

- Daily requirements of some elements is very very less.

IRON

- In body it is found in
  - Haemoglobin
  - Myoglobin
  - Ferritin
  - Hemosiderin
  - Transferrine
  - cytochromes

- RDA is 10-20mgs.
- Sources are meat, fish, eggs, cereals & green leafy vegetables.

- **Milk is deficient in Iron.**

ABSORPTION IS THROUGH INTESTINAL MUCOSA

- It combines with intracellular binding protein Apoferritin to ferritin. Almost 300 ferric ions can bind to one molecule of apoferritin..

- For transport, free iron binds to Apo transferrin, in blood to form transferrin.It is the major

- transport form of iron. It also prevents toxicity of free iron.

HEMOSIDROSIS

- Excessive binding of iron causes denaturation of ferritin molecule. It undergoes aggregation, to form hemosiderin.

- Mobilization of iron from hemosiderin is very slow. accumulation of hemosiderin is known as hemosiderosis.

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- Massive deposits of hemosiderin in tissues lead to hemachromatosis.

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HARMFUL EFFECT OF HEMACHROMATOSIS:

- Damage to:
  - liver,
  - pancreas, it damages ß cells, result in Bronze diabetes.
  - skin of the patient has bronze coloration.
  - Oxidative damage to cardiac muscle is a biggest concern.

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- Iron is stored in liver, spleen and bone marrow

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CAUSES OF IRON DEFICIENCY:

- Reduced dietary intake.
- Hemolysis
- Children who are on milk diet only are prone to iron deficiency.
- Chronic bleeding, irregular menstrual cycles
- Peptic ulcer, piles
- Hook worm infection
- Repeated malarial infections.

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- Deficiency leads to Iron deficiency anaemia or hypochromic microcytic anaemia.
- It is associated with low hemoglobin and ferritin

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Cu^{++}

- Humans contain around 100 mgs of copper. Liver, brain, kidney and heart are rich in copper.
- Free copper is 4%, 96 % is bound to Ceruloplasmin in body.
- **Sources: cereals, legumes, raisins, nuts etc**

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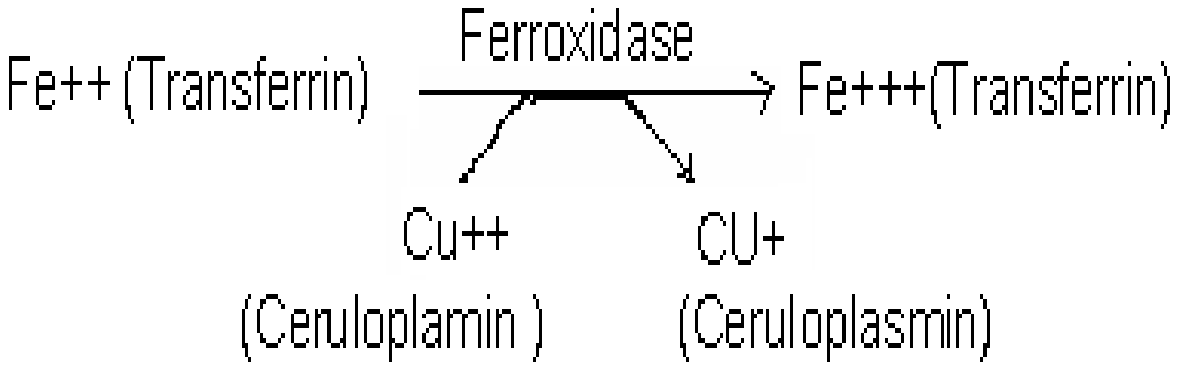
FUNCTIONS

- Cofactor of enzymes like:
- cytochrome oxidase
- dopamine decarboxylase
- Tyrosinase
- Cyt.C oxidase
- superoxide dismutase
- monoamine oxidases
- Tyrosyl oxidase



COPPER DEFICIENCY:

- Causes anaemia.(Microcytic,normochromic anemia)

- Failure of melanin formation because tyrosine oxidase becomes inactive.

- **Menke's disease or Kinky hair syndrome:**

- It is fatal sex linked recessive disorder in which there is cerebral and cerebellar degeneration,
- connective tissue abnormalities and kinky hair.
- Both serum [Copper] and [Ceruloplasmin] is low.

- **Wilson's disease: It is an Autosomal, recessive disorder. There is a decrease in the biliary**
- excretion of copper. Blood and tissue copper is high in these patients.

- It leads to retention of copper, followed by hepato-lenticular degeneration.

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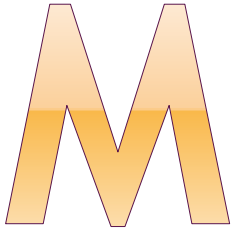
MAGNESIUM

- **Sources:**
  - Vegetables
  - Cereals
  - Beans
  - Potatoes
  - Cheese
  - animal tissues



- It is absorbed from the small bowel.
- It is excreted through feces, urine and sweat.

FUNCTIONS

- It is a cofactor for peptidases, ribonucleases, glycolytic enzymes
- High levels depress nerve conduction, low levels may cause Tetany.

- Major part is found in bones. In teeth, it is present as dentin and enamel.

FLUORINE

- It is solely derived from water, tea, and fish
- Daily intake should not be more than 3mg.
- It is absorbed by diffusion from intestine
- Mostly it is found in the bones and teeth.
- It is eliminated in the urine.

FUNCTIONS OF F

- important for tooth development
- prevention of Dental Caries.
- promotes bone development,
- increases retention of calcium and phosphate, prevent osteoporosis

FLUROSIS

- is due to toxicity of fluoride
- It damages mitochondria
- Inhibit enzymes which depend on Mg, like Succinic dehydrogenase.
- Protein synthesis decreases in muscle, heart, kidney, lungs, pancreas and spleen.

- Collagen synthesis is adversely affected.

IODINE

- **Sources:**
- **Vegetables, fruits obtained from sea shore, sea fish are rich in iodine. People who live**
- on hills do not get iodine from diet. They are prone to suffer from deficiency.
- It is absorbed from small intestines and transported as protein complex in plasma.

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FUNCTION OF

- Synthesis of thyroid hormone

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ZINC

- **Sources are liver, milk, fish, dairy products, cereals, legumes, pulses, and** spinach etc.
- It is absorbed in duodenum and ileum. Absorption of Zinc from the intestine
- It is transported bound to a protein (α2-macroglobulin and transferrin)
- RDA is 15-20mgs for adult, 3-15mgs for infants and children

- Zinc is important for the activity of a number of enzymes like
  - Carbonic anhydrase
  - DNA, RNA polymerases
- Release of vitamin A from liver requires Zinc.
- participates in the regeneration of rhodopsin (visual cycle).
- Insulin is secreted, stored as a complex of Zinc
- Helps in wound healing.

DEFICIENCY OF ZINC:

- Results in dwarfism and hypogonadism
- Delayed sexual development
- It decreases spermatogenesis in males
- irregular menstrual cycles in females.
- Hepatosplenomegaly

- Selenium is rich in liver, kidney, finger nails. Usually plant products are good sources than
- animal based diet.
- It is absorbed from duodenum, transported as selenomethionine. It forms a complex with
- plasma proteins for transport. In tissues, free selenium is released.
- It is excreted in urine.
- RDA 50-100 µg Adult

- Glutathione peroxidase is a selenium dependent enzyme.
- It promotes digestion, absorption of lipids and vitamin E.
- It is a part of glutathione peroxidase, prevents peroxidation of PUFA in the membranes.
- It helps in the retention of vitamin E in the blood.
- It is a cofactor for an enzyme involved in the synthesis of thyroid hormone.

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- **Deficiency of selenium:**
- • Liver cirrhosis
- • Pancreatic degeneration
- • Myopathy, infertility
- • Failure of growth

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- **Toxicity:**
- - Selenium toxicity is called Selenosis
- - Toxic dose is 900micro gram/day
- - It is present in metal polishes and anti-rust compounds